Using the GPS Leader™for Household Surveys and Other Applications

AASHTO GIS-T 2001 - April 10, 2001

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GPS Leader™
An Innovative Device for Data Collection

- First commercially available GPS-based data collection device for traffic and transportation studies
- Designed for in-vehicle use
- Compact, rugged, highly integrated
- Customizable user interface for different data collection/ survey applications
- Advanced Battelle technology

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Battelle's GPS Leader

Package Includes:

- Main unit
- Palm OS PDA
- GPS antenna
- Cables
- Software for downloading and managing data
- Documentation and video

GPS Leader Features

- GPS-based data collection device
- Data collected: (every second)
  - Vehicle location in latitude & longitude (from GPS)
  - Travel speed (from GPS)
  - Driver/occupants and trip purpose data (from handheld user interface)
- Stores 5 to 7 days of detailed trip data for later download/analysis
  - Approximately 70 hours at the one-second level

Applications for In-Vehicle GPS Technology

- Personal or Household Surveys
  - Transportation Planning, Travel Demand Analysis
- Vehicle Activity Surveys
  - Commercial Truck Survey
- Emission Modeling and Duty Cycle Studies
  - Calibration for Microscopic Simulation, Evaluate Engine Stress to Improve Performance
- Travel Time Studies
  - Congestion Management
- Fleet Performance / Operations Analysis
  - Evaluate Driver Behavior, Evaluate Fleet Productivity and Identify Areas of Improvement

Who Can Benefit from GPS Deployment?

- Transportation Planning Agencies
  - All levels: State, Region, County, City, and MPO
  - Collect detailed and accurate travel behavior data unavailable from traditional telephone survey
- Traffic Engineers
  - Automate and improve accuracy in travel time data collection for evaluating traffic signal timing and congestion management
- Commercial and Public Fleet Managers
  - Study fleet performance for improving operations of transit, public vehicles, commercial delivery vehicles, etc.
- Traffic/Transportation Researchers

Household Travel Surveys: Key Benefits

- Determine
  - under-reporting of trips
  - trip rate correction factors
- Improve the accuracy of specific trip elements
  - trip start and finish time
  - origin and destination
  - distance
  - duration
- Obtain data on
  - route choice
  - highway functional class usage
    - time of day, trip purpose, and travel speed

Household Travel Surveys: Important Considerations for Implementation

- Length of deployment
  - multiple days improves accuracy
    - non-driving days
    - day-of-week variations
- Number of vehicles per household
- Device efficiency rate
- Technology bias
- Participant's Primary Language
- Tradeoff between in-vehicle versus multi-modal operation

Household Travel Surveys: Study Implementation

- Recruitment and scheduling
- Device setup and deployment
- Installation and use
- Return of equipment
- Downloading GPS and survey data
- Pre-processing
- Analysis

Household Travel Surveys: Installing the GPS Leader

- Place the antenna outside the vehicle
- Install the power plug (and splitter, if necessary)
- Check to make sure the control unit and PDA are connected
- Place the control unit out of the way

Household Travel Surveys: Entering Data

- Turn on vehicle, then PDA
- Press 'START'
- Never need to enter data while vehicle is in motion

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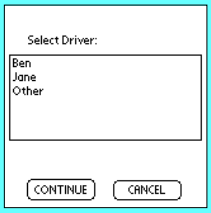
Household Travel Surveys: Entering Data

- Select driver from pre-populated list
- Select any passengers, if any, from pre-populated list
- Stow PDA and begin driving



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Household Travel Surveys: Entering Data (cont.)

- Stop vehicle and select 'END TRIP'
- Select trip purpose for each occupant (will vary for each survey)
- Indicate whether you are at your final destination or an intermediate stop

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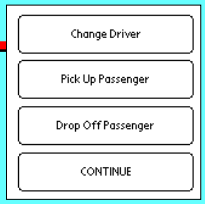
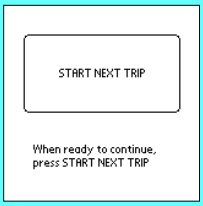
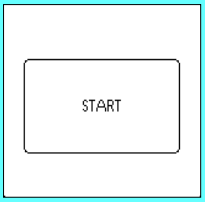
Household Travel Surveys: Entering Data (cont.)

- For intermediate stops, indicate whether
  - there is a change in driver
  - you picked up a passenger
  - you dropped off a passenger
- Otherwise, device is ready for next trip







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Household Travel Surveys: Sample Summary Data

Admin Time: 02/02/01 16:38:54

Device ID: 2 | Timer: 0 min | GPS Sample Rate: 1 sec | GPS Powered: At Power-On | Application: Personal Travel Survey
Source: Ignition | Idle Speed: 6 km/hr | Analog Sample Rate: 0 sec | PDA Powered: At Power-On | Micro Version: 2.00
Idle Time: 30 sec | Idle Sample Rate: 30 sec | GPS Type: Standard | PDA Version: 1.00p

Chain Number	Trip Number	Start Time	End Time	Number of GPS Records: Bad	Good	Speed > Idle	Distance (miles)	Duration (min)	Occupants	Driver Purpose	PDA Trip	Import Flag
1	1	02/02/01 16:38:57	02/02/01 16:39:04	2	0	0	0	0.12			No	0
2	1	02/02/01 19:15:41	02/02/01 19:18:22	29	1	0	0	2.68			No	0
3	1	02/02/01 19:18:24	02/02/01 19:33:33	0	503	462	5.34	15.15	2	5,9	Yes	0
4	1	02/02/01 19:35:28	02/02/01 19:35:53	0	0	0	0	0.42			No	0
5	1	02/02/01 19:35:56	02/02/01 19:41:11	1	150	109	0.69	5.25	3	4,28	Yes	0
6	1	02/02/01 21:04:46	02/02/01 21:05:57	3	16	0	0	1.18			No	0
7	1	02/02/01 21:05:59	02/02/01 21:11:21	0	149	122	0.94	5.37	3	1,2	Yes	0
	2	02/02/01 21:11:30	02/02/01 21:24:02	0	415	382	5.27	12.53	2	7,30	Yes	0
8	1	02/03/01 12:37:56	02/03/01 12:38:45	20	1	0	0	0.82			No	0
9	1	02/03/01 12:38:47	02/03/01 12:51:28	0	365	321	3.5	12.68	3	3,8	Yes	0
	2	02/03/01 12:52:10	02/03/01 14:08:53	11	2869	2858	66.71	76.72	3	5,10	Yes	0
10	1	02/03/01 16:42:24	02/03/01 16:43:06	27	0	0	0	0.7			No	0
11	1	02/03/01 16:43:08	02/03/01 18:47:33	11	1984	1736	28.75	124.42	6	1,2	Yes	0
12	1	02/03/01 18:47:41	02/03/01 18:51:08	0	7	0	0	3.45			No	0
13	1	02/03/01 18:51:10	02/03/01 20:09:31	8	2952	2911	65.26	78.35	3	7,30	Yes	0
14	1	02/04/01 10:15:31	02/04/01 10:19:08	28	16	5	0.04	3.62			No	0
15	1	02/04/01 10:19:10	02/04/01 10:28:38	0	327	299	3.99	9.47	2	10,11	Yes	0
16	1	02/04/01 11:59:38	02/04/01 11:59:58	7	6	0	0	0.33			No	0
17	1	02/04/01 12:00:00	02/04/01 12:11:18	0	402	338	3.98	11.3	2	7,30	Yes	0

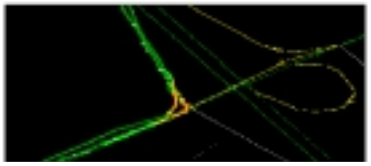
Household Travel Surveys: Matching GPS and Interview Trips

- Sort both by time (and date) of day
- Compare start time, end time, trip duration, and trip distance for pairs of trips
- Use automated statistical algorithms to identify matches
- Analyst visually verifies matches and non-matches
- Create final dataset for statistical analysis

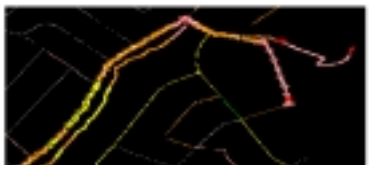
Household Travel Surveys: Analysis

- Develop overall trip rates for the same strata used to define the travel day sampling frame
- Compare these estimates to those based on household interviews
- Using only matched trips, compare estimates of travel times and trip distances and possibly vehicle occupants and trip purpose
- Develop recommended adjustment factors for trip rates, trip distance, and travel time

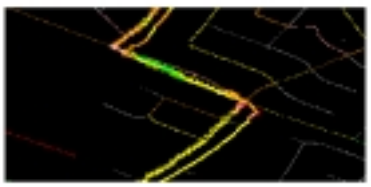
Examples of Map-Matched Travel Data

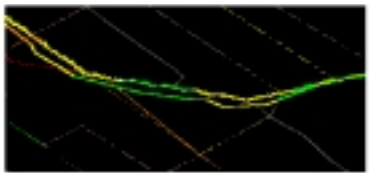


map-matching improves accuracy, allowing distance calculations using the road network rather than the GPS points



requires careful attention at trip ends or where the road network does not exist





Vehicle Activity Surveys

- Unobtrusive data collection without the handheld unit
- GPS Leader senses vehicle ignition
- Powered by vehicle – don't have to worry about running down internal batteries
- Large data storage capacity can handle long-distance trips
- Allocate vehicle location properly to
  - air basins, counties, urban areas

Travel Time Studies

- Systematic deployment on the local or regional transportation network for congestion management
- Identify specific points of delay and congestion
- Aggregate travel times on specific roadway segments
- Increase use at different periods (e.g., morning and afternoon peaks) for more detailed estimates
- More accurate than stopwatch method and does not require two people for data collection

Emission Modeling and Duty Cycle Studies

- Can measure:
  - starts and stops
  - acceleration and deceleration
  - cruising speeds
- Understand how vehicle activity contributes to airborne emissions
- Understand how vehicles are typically driven to better understand issues relating to wear and tear
- Event port can receive data from external sensor (e.g., direct emissions measurement)

Fleet Performance/Operations Analysis

- Cheaper to rotate units among the fleet than to purchase and permanently install expensive telematics systems
- Understand:
  - how vehicles are typically being driven
    - speeds, aggressive starts and stops, etc.
  - how drivers choose their routes and other behavior